

resin composition and a coating film, a soft touch to the hands of the drivers, and a lower manufacturing cost.

In Takimoto '333, it is clear that the above object is completed not only by phthalic acid ester, but also by the combination of NBR and phthalic acid ester. Thus, to replace the NBR with polyethylene would destroy the purpose of Takimoto '333.

Takimoto does not address the problems associated with high and low temperatures, nor the solutions thereto.

JP '345 discloses a composition having a vinyl chloride, plasticizer of ethyl hexyl phthalate with filler and thermoplastic polyurethane. The object of JP '345 is to obtain vinyl chloride resin composition having high impact resilience, high mechanical intensity and good workability, especially to improve the impact resilience. For the convenience of the Examiner, attached is an English translation of Japanese unexamined patent publication '345.

JP '345 has no disclosure regarding how to obtain well balanced low/high temperature characteristics.

One of ordinary skill in the art looking to solve the problems associated with low and high temperature characteristics would not be motivated to look to either of Takimoto '333 or JP '345 because neither of these references addresses the problems of low/high temperatures nor solutions thereto.

Furthermore, replacing the NBR of Takimoto '333 with the polyethylene of JP '345 to would destroy the purpose of

Takimoto '333 and, therefore, one of ordinary skill in the art would not be motivated to make such a combination.

However, even if one of ordinary skill in the art did combine Takimoto '333 with JP '345, the claimed invention would not be taught or suggested by such a theoretical combination.

The claimed invention relates to a steering wheel pad comprising a soft vinyl chloride resin composition which comprises a vinyl chloride resin, a thermoplastic aliphatic polyurethane (TPU) and an alkyl phthalic ester of a defined formula which has a linear chain ratio of an ester group (normal portion) of 80% or more. The thermoplastic aliphatic polyurethane and the phthalic ester are, respectively, present in amounts of 20 to 150 parts by weight and 60 to 150 parts by weight based on 100 parts by weight of the vinyl chloride resin.

The criticality of the claimed components is clearly disclosed in the present specification. The claimed steering wheel pad surprisingly exhibits low temperature flexibility, heat resistance, thermal aging resistance, and resistance to light in a usable temperature range from -40°C to 100°C.

Figure 1 illustrates the relationship between the  $\tan \delta$  peak temperature and the tensional modulus. The low temperature characteristic expressed in terms of the  $\tan \delta$  peak temperature and the tensional modulus at 100°C are known by one of ordinary skill in the art to be characteristics which are contrary to each other. It has been generally accepted that where importance is

placed on the heat resistance in soft polyvinyl chloride compositions, higher phthalic acid esters such as DIDP are appropriate. In this case, the  $\tan \delta$  peak temperature is shifted to a higher temperature side, such as comparative example C9 in Figure 1.

On the other hand, when importance is placed on the cold resistance, it is accepted that use of aliphatic acid esters such as adipates, sebacates and the like is favorable. In this case, the tensional modulus at 100°C is significantly lowered with a loss of practical strength and also with a considerable loss of durability.

When the combination of PVC/TPU/normal phthalic acid ester according to the claimed invention is used, surprisingly the low temperature characteristic/high temperature characteristics are well balanced which is not attained by prior art counterparts. This effect has been found for the first time, according to the claimed invention, and is illustrated in Figure 1.

Further, because the normal phthalic acid ester present in the improved composition of the claimed invention has 7 to 9 carbon atoms the composition is resistant to light and bleeding of the plasticizer is suppressed. Please see page 12, lines 13-15 of the present specification.

In view of the improbable combination of cited prior art, the many differences between the claimed invention and the

KOIZUMI et al -- Appln. No. 08/147,433

theoretical combination of the cited prior art, and the many unexpected advantages of the claimed invention, withdrawal of the § 103 rejection is respectfully requested.

The rejection of claims 13, 14, 16, 17, 19 and 22-24 under 35 U.S.C. § 103 over Takimoto '333 in view of JP '348 is respectfully traversed. JP '348 cannot be properly cited against the claimed invention because the foreign priority date of the subject application is May 24, 1991, which precedes the foreign publication date of JP '348, which is June 14, 1991.

Accordingly, withdrawal of the § 103 rejection is respectfully requested.

In view of the above, reconsideration and allowance of the subject application are respectfully requested.

Respectfully submitted,

CUSHMAN, DARBY & CUSHMAN

By



G. Lloyd Knight

Reg. No.: 17,698

Tel. No.: (202) 861-3090

Fax. No.: (202) 822-0944

GLK/JSM:zmb

Enclosure

1100 New York Avenue, N.W.  
Ninth Floor - East Tower  
Washington, D.C. 20005-3918  
(202) 861-3000



Japanese Unexamined Patent Publication Tokkai-Sho 60-92345

Publication Date: May 23, 1985

Application No. Sho 58-20016

Filing Date: Oct. 26, 1983

Inventors: Yuichiro Kushida et al.

Applicant: Denki Kagaku Kogyo K.K.

### Specification

#### 1. Title of the Invention

Vinyl Chloride Resin Composition

#### 2. Claim for Patent

A vinyl chloride resin composition characterized in that it mainly comprises 100 parts by weight of vinyl chloride resin having a polymerization degree of 1500 or more; 70 to 200 parts by weight of plasticizer; and 20 to 200 parts by weight of thermoplastic polyurethane resin.

#### 3. Detailed Description of the Invention

The present invention relates to a vinyl chloride resin composition which is excellent in impact resiliency, processing ability and mechanical strength.

Soft vinyl chloride resins with which plasticizers are blended have heretofore been widely used as materials for hoses, gaskets, leathers, films, electric cable coatings and shoe soles.

Although the soft vinyl chloride resins have been used in applications in which they are used as rubber, their applications

are limited since they have poor rubber resilience which is represented by impact resiliency value.

Even if a high polymerization degree vinyl chloride resin having an average polymerization degree of 2000 or more is used, an enhancement in impact resiliency is low.

If vinyl chloride resin is blended with acrylonitrile-buthadiene copolymer containing gel which is insoluble to methyl ethyl ketone together with a plasticizer as is described in Japanese Unexamined Published Application No. Sho 57-187341, its compression set would be improved to some extent, the impact resiliency would be hardly improved and the mechanical strength would be lowered.

It was found from present inventor's study for improving the impact resiliency of vinyl chloride resin blend that a vinyl chloride resin composition mainly containing three components such as vinyl chloride resin having a high polymerization degree, a large amount of plasticizer and thermoplastic polyurethane has considerably improved mechanical strength and impact resiliency while keeping the processing ability inherent in vinyl chloride resin. The present invention was made based upon such finding.

The present invention provides a novel vinyl chloride resin composition characterized in that it mainly comprises 100 parts by weight of vinyl chloride resin having a polymerization degree of 1500 or more; 70 to 200 parts by weight of plasticizer; and 20 to 200 parts by weight of thermoplastic polyurethane resin, which is remarkably excellent in impact resiliency which is not possessed by the prior art soft vinyl chloride resin composition and has highly balanced processing ability and mechanical

properties.

The vinyl chloride resin which is used in the present invention is a vinyl chloride polymer or a copolymer of vinyl chloride with a small amount of copolymerizable one or more monomers. Its manufacturing method may include various methods such as bulk polymerization, suspension polymerization, emulsion, polymerization, solution polymerization and the like.

The monomer which is copolymerizable with vinyl chloride may include  $\alpha$ -olefins such as ethylene, propylene; vinyl esters such as vinyl acetate, vinyl stearate; vinyl ethers such as methyl vinyl ether; lauryl vinyl ether; acrylates and methacrylates such as methyl acrylate and methyl methacrylate; amides such as methacryl amid and acrylonitrile; nitriles; styrenes such as styrene and  $\alpha$ -methyl styrene; and polyfunctional monomers such as diaryl phthalate, ethylene glycol dimethacrylate.

Vinyl chloride resin having a polymerization degree of 1500 or more is used. If vinyl chloride resin having a polymerization degree of not more than 1500 is used, resultant composition would have an insufficient impact resiliency.

The kind of the plasticizers is not particularly limited. Similarly to prior art soft vinyl chloride resins, the plasticizer may include phthalates such as di-2-ethyl hexyl phthalate, dibutyl phthalate, dihexyl phthalate; adipic acid esters such as di-2-ethyl-hexyl adipate; sebacic acid esters such as dibutyl sebacate; trimellitates such as tri-2-ethylhexyl trimellitate and epoxy compounds such as epoxy soyabean oil. Seventy (70) to 200 parts by weight of plasticizer is added to 100 parts by weight of vinyl chloride resin.

If not more than 70 parts by weight of plasticizer is added, intimate mixing of the vinyl chloride resin with thermoplastic polyurethane resin could not be smoothly carried out so that processing ability is low. In case of 200 or more parts by weight of the plasticizer, mechanical properties of the composition is low. Therefore, addition of 70 to 200 parts by weight of the plasticizer is appropriate.

The thermoplastic polyurethane resin may be polyester-polyol type or polyether-polyol type polyurethane. 20 to 200 parts by weight of the thermoplastic polyurethane resin is added to 100 parts by weight of vinyl chloride resin. When not more than 20 parts by weight, the composition is inferior in mechanical properties and impact resiliency. When higher than 200 parts by weight, excellence in processing ability which is specific in the vinyl chloride resin is lost.

Further, other high molecular auxiliary agents such as ethylene-vinyl acetate copolymer, acrylic resins, chlorinated polyethylene, acrylonitrile, styrene-butadiene copolymer, chloro-sulfonated polyethylene, acrylonitrile-butadiene copolymer may be added.

It is apparent that the vinyl chloride resin composition may be added with heat stabilizer, filler, lubricant, foaming agent, fire-retardant and pigment if necessary.

Mixing and molding of blends including as main components, vinyl chloride resin, thermoplastic polyurethane and plasticizer for producing the vinyl chloride resin composition of the present invention may be conducted by any method provided that the components are substantially uniformly dispersed, mixed and



kneaded. For example, the components are dry-blended with a Henschel type mixer or ribbon blender. The dry blended powders may be directly molded, or the powder may be molten and kneaded and then pelletized. The pellets may be molded. Molding may be conducted by any one of extrusion molding, injection molding, blow molding, calendar molding, vacuum forming depending upon the desired shape and performances of the desired product.

Applications of the vinyl chloride resin composition of the present invention include hoses, gaskets, artificial leathers, films, electric conductor coating materials, shoe soles, etc.

For further easy understanding of the present invention, the present invention will now be described in detail by way of examples and comparative examples. It is to be understood that the present invention is not limited to only these examples.

#### EXAMPLES 1 to 6.

One hundred (100) parts by weight of vinyl chloride resin (Bunka vinyl SH-250) having an average polymerization degree of 250 and 3 parts by weight of barium, zinc fatty acid salt complex stabilizer were add to a Henschel mixer, the jacket of which is kept at 90°C. High speed agitation was conducted until the temperature of the content becomes 60°C. A given amount of di-2-ethylhexyl phthalate (hereinafter referred to as DHP) and dihexyl phthalate (hereinafter referred to as DP) was added. When the temperature of the content become 120°C, cooling is started. When it become 50°C, a given amount of thermoplastic polyurethane shown in Table 1 was added. The content was removed after about 5 minute agitation.

The removed vinyl chloride resin composition was roll-milled for 10 minutes by two rollers having surfaces which are at 160° C after retention on rolls.

Test samples were prepared by press-forming the rolled sheet for tests of its harness, impact resiliency and tensile. Results are shown in Table 1.

(1) Roll processing ability

Roll processing ability was assessed based upon time which was taken since 200 g of dry blended powder was charged on 8-inch rolls having 160°C surface until the powder was retained on rolls to become an uniform roll.

- : not more than 60 sec.
- : 60 sec or more and not more than 120 sec.
- : 120 sec. or more

(2) Hardness JIS K60301

spring method JIS-A type 6 mm x 2

(3) Impact resiliency JIS K 6301

(4) Tensile strength JIS K 6723

(5) Elongation JIS K 6723

It is found from Table 1 that the vinyl chloride resin composition of the present invention has roll a processing ability and mechanical strength which is equal to or higher than those of the prior art composition and an improved impact resiliency.

Comparative examples 1 to 5

Results of comparative example 1 in which thermoplastic polyurethane used in the example 1 was not added, comparative

example 2 in which 50 parts by weight of plasticizer was added, comparative example 3 in which 250 parts by weight of plasticizer was added, comparative example 4 in which 250 parts by weight of thermoplastic polyurethane was added, and comparative example 5 in which the polymerization degree of the vinyl chloride resin was as low as 1100 are shown in Table 1. It is apparent that any of the physical properties of the results of the comparative examples is worse than the relevant results of examples.

Table 1

	EXAMPLES						COMPARATIVE EXAMPLES				
	1	2	3	4	5	6	1	2	3	4	5
Conditions	2500	4000	4000	4000	4000	6000	2500	4000	4000	4000	1100
	polymerization degree of vinyl chloride resin	DOP	DOP	DOP	DHC	DOP	DOP	DOP	DOP	DOP	DOP
	kinds of plasticizers	150	150	100	150	180	150	50	250	150	150
	amount of plasticizer (parts by weight)	50	100	50	30	100	-	50	50	250	50
Results	amount of thermoplastic polyurethane (parts by weight)										
	roll processing ability	o	o	o	o	o	o	x	o	x	o
	hardness	51	53	60	48	53	52	75	40	60	51
	tensile strength (kg/cm <sup>2</sup> )	101	110	150	100	115	55	233	55	350	75
	elongation (%)	350	470	550	370	450	500	520	600	600	450
	impact resiliency (%)	48	53	45	45	51	23	24	45	45	30